Test New Electric Incinerator Design For Sterilizing Laboratory Air

Two sizes of an electric air sterilizer designed for long operational life and ease of maintenance were tested for effectiveness in sterilizing air containing heavy concentrations of bacterial spores. Here are the results.

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THE STUDY of respiratory transmission of infectious diseases, in which experimental infectious aerosols are used, creates problems in aerosol containment and disposal. These aerosols may be a hazard to laboratory personnel and to persons nearby.

Similar problems with infectious microorganisms are encountered in handling dried micronized disease agents or in using small culture tanks.

Experimenters can be protected by enclosing the aerosol producing device in a gas-tight enclosure maintained at a negative pressure.[1] The air withdrawn from such an enclosure, however, may be highly contaminated. It must be sterilized, therefore, before it is discharged to atmosphere.

Air can be sterilized by various methods, such as ultraviolet radiation,[2] filtration,[3,4] and direct heat.[5] Among the incinerators that have been used are an electric unit suitable for sterilizing approximately 1 cfm of air[6] and an electric grid type of sterilizer capable of handling 100 cfm of air.[7] The latter type has been used in our facilities. This type, however, requires the installation of an extended retention tube. And when the grid breaks down, the sterilizer must be removed in order to repair it.

Described herein is a design that overcomes these disadvantages by providing for a built-in retention time and on-site maintenance and heater replacement.

16 and 100 cfm Models

The sterilizer design is scaled to two sizes. One sterilizes air in volumes up to 16 cfm; the other sterilizes up to 100 cfm. As shown in Fig. 1, each consists of five concentric cylinders of stainless steel with tubular heaters inserted into the central cylinder. The tubular heaters are available from many sources in wide ranges of ratings and sizes. The 16 cfm sterilizer has two heaters (1750 watts, 230 volts); the 100 cfm sterilizer has six (3000 watts, 230 volts). The outside cylinder is jacketed with 2 in. of insulation. The air is drawn in over the heaters and makes five passes back and forth before being discharged to the outside. An internal sensing thermoswitch maintains the temperature at a preset level. The 16 cfm model is 30 in. long and 12 in. in diameter; the 100 cfm model is 58 in. long and 20 in. in diameter.

For testing, a 1 cu meter aerosol chamber was attached by a length of round duct to the input end of the sterilizer. An air stream was passed through the sterilizer by an electric fan, with the flow controlled by dampers.

How Tests Were Run

The sterilizer temperature and the air flow were stabilized at desired levels. Air flow was determined in the duct at the input end of the sterilizer by a heated thermocouple anemometer. Temperature was measured in the duct 6 in. from the discharge by using a thermocouple (iron-constantan) and a recording potentiometer. An aerosol of *Bacillus subtilus* var. *niger* spores was disseminated into the aerosol chamber by means of a Chicago type nebulizer.[8] Previous to use, the suspension was heat shocked at 80 C for 15 minutes. The concentration of viable spores in the aerosol (1×10^8 per cu ft) was determined by sampling the contaminated air passing into

[1]Superscript numerals indicate references on p. 95.

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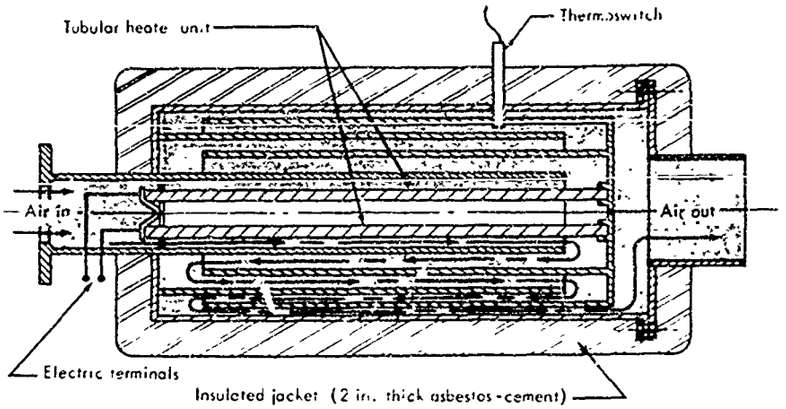
the sterilizer with liquid impingers, serially diluting the impinger fluid, and plating aliquots on corn steep agar* surfaces contained in Petri dishes. Effluent air samples withdrawn at a distance of 1 ft from the exhaust end of the incinerator were passed through sieve type samplers containing a solid impingement medium,* using a previously employed method.[7] Plates were incubated at 37 C for 48 hours. Aerosol generation and sampling were continuous throughout each 30 minute test at each temperature.



1 DESIGN of electric air sterilizer is illustrated here. Results of testing with 16 and 100 cfm models are shown in Tables 1 and 2.

Tests Prove Design

The results of these experiments are shown in Tables 1 and 2. For tests with each size sterilizer, the temperature was varied while air flow remained the same. The design flow rates of 16 and 100 cfm were used for the smaller and larger units, respectively.

The data show that the two sterilizers, when operated at design flow rates, will sterilize air containing aerosol concentrations of spores of 1×10^8 per cu ft. In some additional tests with the smaller unit at a flow rate of 20 cfm. a maximum temperature of 330 F was recorded. and sterilization was not achieved.

Laboratory experiments with infectious microorganisms sometimes require the use of infectious aerosols, or such aerosols may be accidentally created by the equipment. Effluent air from such operations must be sterilized. The most effective treatment is incineration. The sterilizers described herein are suitable for this purpose. The tubular heaters are long-lived and can be replaced without disconnecting the sterilizer from its ductwork. The compact design requires no additional retention tube, which permits installation in a small space.

When operated at design air flow, each sterilizer has reserve heating capacity to allow for some variation in air flow and temporary power failures. ≠

*Black strap molasses, 10g; treated corn steep liquor, 30g; agar, 20g; distilled water, 1000 ml; adjust to pH 7.

TABLE 1—TEST DATA indicate effectiveness of 16 cfm electric sterilizer against a viable spore concentration of 1×10^8 per cu ft, using *Bacillus subtilis*.

Temperature, F	Spore recovery* Test 1	Test 2
310	+	+
320	+	+
330	+	+
340	+	+
350	0	+
360	0	0
370	0	0
380	0	0
390	0	0

TABLE 2—TEST DATA indicate effectivness of 100 cfm electric sterilizer against a viable spore concentration of 1×10^8 per cu ft, using *Bacillus subtilis*.

Temperature, F	Spore recovery* Test 1	Test 2
376	+	+
383	+	+
386	0	+
389	0	+
402	0	0
419	0	0
422	0	0
425	0	0

*Recovery of viable spores from duplicate tests of 30 minutes each: + indicates viable spores were recovered; 0 indicates no viable spores were recovered.

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